DOCUMENT RESUME

ED 200 443 SE 034 594

AUTHOR Howe, Trevor G.; Gerlovich, Jack A.
TITLE National Study of the Estimated Supply and Demand of Secondary Science and Mathematics Teachers. Technical Report No. 23.
INSTITUTION Iowa Univ., Iowa City. Science Education Center.
PUB DATE Mar 81
NOTE 50p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Bachelors Degrees; *Employment Patterns; Employment Problems; *Employment Qualifications; Masters Degrees; Mathematics Education; *Mathematics Teachers; *National Surveys; Science Education; *Science Teachers; Secondary Education; Secondary School Science; Surveys; *Teacher Supply and Demand

ABSTRACT

This report presents complete data which identify specific areas of supply/demand inconsistencies in the state of Iowa by science discipline of secondary science teachers. Summarized are data concerning the number of graduates from teacher education institutions in Iowa completing preparation for a teaching certificate for the years 1979-80, and the following data concerning Iowa public high school science teachers for 1973-74 and 1978-79: subject area taught, education, school district size, with undergraduate or graduate majors in their teaching area. Results are also presented of a national telephone survey conducted by personnel of the Iowa State University Education Placement Office and Iowa Department of Public Instruction for each state which assesses the availability of information concerning the supply and demand of secondary school mathematics and science teachers. (CS)

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The University of Iowa

March 1981

technical report 23

National Study of the Estimated Supply and Demand of Secondary Science and Mathematics Teachers

by

Trevor G. Howe
and
Jack A. Gerlovich

SE 034 594

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Robert E. Yager, Coordinator
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NATIONAL STUDY of the ESTIMATED SUPPLY and DEMAND of SECONDARY SCIENCE and MATHEMATICS TEACHERS

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Table of Contents

Introduction 1

Report on the Iowa Studies
- Introduction. 3
- Methodology 4
- Findings. 5
- Summary 10

The National Study
- Problem 15
- Methodology 15
- Findings. 18

Summary 28

Implications 30

References 32

Appendix A 33

Appendix B 35

Appendix C 36

Appendix D 37

The Technical Report Series List 39

Table of Tables

Table 1 - Actual Public School Enrollments in Iowa for 1972-73 thru 1980-81 and Estimates for 1981-82 thru 1985-86. 6

Table 2 - Comparison of the Number of Fall Vacancies in Mathematics and Science in the Public Schools of Iowa with the Number of Bachelor Degree Graduates Certified to Teach from the Twenty-Seven Iowa Institutions for the Years Indicated. 7

Table 3 - Summary of the Number of Graduates from the Twenty-Seven Teacher Education Institutions in Iowa Completing Preparation for a Teaching Certificate with a Bachelor Degree by Subject Area for the Years 1970-80 9

Table 4 - Iowa Public High School Science Teachers by Subject Area, Education, and School District Size (1973-74). 11

Table 5 - Iowa Public High School Science Teachers by Subject Area, Education, and School District Size (1978-79). 12

Table 6 - Iowa Science Teachers with Undergraduate or Graduate Majors in their Teaching Area by Subject and School District Size. 13

Table 7 - Summary of a Telephone Survey on the Availability of Information on the Supply and Demand of Secondary Mathematics and Science Teachers for a Sample of Thirty States. 19

Table 8 - Availability of Data on the Number of Individuals Certificated and the Number Hired in Each State. 23

Table 9 - Estimated Supply of Secondary Biology, Chemistry, Physics, General Science, Earth Science and Mathematics Teachers by State 26

NATIONAL STUDY of the ESTIMATED SUPPLY and DEMAND of SECONDARY SCIENCE and MATHEMATICS TEACHERS

Introduction

In a September 1980 editorial in Science, Young stated that a high priority for both scientists and engineers should be directed toward improving the understanding of science and engineering . . . This can be achieved by educating those already in place . . . and by placing more emphasis on science and engineering in high school and college, where minimal standards of technical literacy should be required of all who aspire to graduate.[1]

A 1980 Science and Engineering Education report to the President warns that the U.S. faces immediate shortages of engineers and computer professionals, as well as a trend "toward virtual scientific and technological illiteracy" in the population at large. The declining emphasis on science and mathematics in our schools runs in marked contrast to other industrialized countries.[2]

A report by E. Walsh and J. Walsh (1980) indicates that schools are not getting and keeping the excellent teachers in science and math that are needed. Many of the quality math and science people are being drained from the education field. They also report that the National Science Teachers Association lost 1,000 of its 10,000 members in 1980. However, science educators perceive the problem to be a lack of serious commitment by government and the science establishment.[3]

In 1978 the Wall Street Journal reported that high school teacher shortages in Illinois existed in the areas of agriculture, industrial arts, special education, math, business education, and science.[4] In 1980, the National Science Foundation (NSF) reported 1,100 math and 400 natural and physical science teaching positions unfilled nationally

in 1977. In addition NSF indicated that school districts across the U.S. reported they will have estimated shortages of 900 mathematics and 700 natural and physical science teachers between 1977 and 1982.[5]

In 1978 the Association for School, College and University Staffing (ASCUS) reported shortages of teachers by region of the country. Teacher shortages were recognized in the following disciplines and geographic regions of the country: Mathematics - considerable shortages in Alaska, South Central and Southeast U.S.; Chemistry - considerable shortage in Alaska, and the South Central U.S.; Physics - considerable shortage in the South Central U.S.[6]

In July 1980 the American Association of Colleges for Teacher Education (AACTE) released a study indicating critical shortages of physics teachers in 14 states, slight shortages in 23 states and no shortage in 2 states.[7] Conflicting reports were discussed concerning the supply and demand for teachers of mathematics. It was reported that accurage predictions could not be made, due to unavailability of representative national studies.

From this background study, it appeared that two needs had to be addressed in order to alleviate the teacher supply/demand problem. First, change the public's apathetic attitude and poor understanding of science; and second, compile complete data which identifies the specific areas of supply/demand inconsistencies by science discipline and state. This study will focus upon the latter, through analyses and application of a recent Iowa study.[8]

REPORT ON THE IOWA STUDIES

Inroduction

In August, 1978, the Curriculum Division of the Iowa Department of Public Instruction (DPI) began receiving an inordinate number of inquiries into the availability of secondary mathematics and science teachers. Such requests are generally made to the DPI only after all other resources (college/university placement offices, peer exchange, media advertisements, etc.) have been exhausted. Many of the requests for secondary physics, chemistry, earth and physical science, and mathematics teachers could not be filled.

Background

Each spring the teacher education graduates from the twenty-seven institutions in Iowa begin their job search. For many years this was not a major task for most candidates. However, to the surprise of many, the thirty year period of teacher shortages ended abruptly with the 1970-71 school year.

This situation coupled with inflation, major changes in the economy, national unemployment, lower birth rates, and declining school enrollments further complicated the teacher placement outlook. The need for additional information led to the current investigations concerning the elementary and secondary teacher supply and demand in all areas for the public schools in Iowa for the years 1971-80.

The first teacher vacancy study was designed in the spring of 1971 as a cooperative survey planned and carried out jointly by the College of Education at Iowa State University and the State Department of Public Instruction. Each year since then, two studies have been conducted, one in the spring and a second in the fall.

Purpose

The purpose of the studies was to investigate the problems of teacher supply and demand, with emphasis in math and science, in Iowa's public schools.

Methodology

Teacher Demand

The target population consisted of Iowa's 447 public school districts who cooperated by supplying information to be used as base line data. Local school districts were designated as the sampling unit. This report contains summary data from the fall surveys conducted over the past nine years.

Teacher Supply

There are 27 institutions in Iowa that have approved teacher education programs. These four year colleges or universities recommend graduates for certification to the Department of Public Instruction. The recent bachelor degree graduate who has completed the preparation for a teaching certificate is the primary source of new teachers in Iowa, accounting for approximately 82% of the new hires.

After studying several alternatives, a survey of the 27 institutions was conducted to ascertain the supply of beginning teachers (i.e., the number of students completing preparation for a teaching certificate with a bachelor's degree). All institutions returned their completed questionnaires.

Since data on the number of graduates were available from an earlier study for the years of 1970 through 1973, the questionnaire for this study was designed to be compatible and to collect information for the years 1974 through 1980.

Findings

One of the variables directly effecting the demand for teachers is declining enrollments. Lower birth rates over the past several years have been reported nationally as well as within the state.

Trends in Iowa public school enrollments in grades K-12 as well as projections may be seen by examination of Table 1. The actual public school enrollments are presented for the 1972-73 school year through 1980-81. Total enrollments have declined 112,707 students in eight years. The projected enrollments are expected to drop 33,997 students in the next four years. Obviously the implication is a reduction in the number of teaching positions at both the elementary and secondary levels over the next several year. However, current data indicate that teacher supply is decreasing more rapidly than student enrollment.

Currently there are approximately 32,000 elementary and secondary teachers employed in the 447 school districts in Iowa. In 1971 there were 93 school districts in Iowa with less than 500 students in grades K-12, currently there are 167 such school districts. Analysis of the data revealed that school size is a factor in teacher turnover. Schools with smaller enrollments appear to have almost three times as many secondary vacancies each year proportionately to the number of teachers employed. This is also true in the next two of the seven school size stratums.

Mathematics

The supply of mathematics teachers as evidenced by the number of certificated bachelor degree graduates from the 27 teacher education institutions has declined sharply. Examination of Table 2 reflects the trend and the severity of the drop. There were 234 graduates in 1970 and only 49 in 1980.

TABLE 1

Actual Public School Enrollments in Iowa for 1972-73 thru 1980-81 and Estimates for 1981-82 thru 1985-86

Public School Enrollments--State																
Year	K	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	Ungraded Special Educ.*	GRAND TOTAL
72-73	46220	44076	45339	48250	49903	51192	51736	52538	51770	49822	49921	48250	45899	634916	10474	645390
73-74	44589	42879	42156	44705	47744	49049	50572	52561	51854	52342	48658	47722	45249	620080	10632	630712
74-75	44635	41379	41123	41496	44364	46977	48893	51290	52190	52481	51140	46147	44326	606441	10649	617090
75-76	46235	42108	40218	40702	41570	44020	47136	49708	51104	53128	51699	49162	43616	600406	10409	610815
76-77	45118	43397	40814	39617	40494	41374	44546	47747	49653	51800	52012	49199	46126	591897	11699	603596
77-78	41139	42629	42032	40201	39328	40119	41467	44469	47645	50260	50808	49809	46311	576437	10676	587113
78-79	37954	39188	40699	41291	39837	38835	39744	41677	44332	48442	49488	48461	46701	556649	10894	567543
79-80	37759	35994	37442	40172	40860	39388	38681	40522	41475	45198	47134	46927	45635	537187	10012	547199
80-81	39202	35737	34492	36910	39867	40318	39068	39372	40263	42570	44179	45571	44726	522285	10398	532683
								ESTIMATED ENROLLMENT								
81-82	39773	36899	34378	33997	36652	39408	40221	39580	39148	40913	41685	42212	42857	507723	10108	517831
82-83	41967	37437	35487	33885	33760	36231	39314	40749	39356	39781	40062	39829	39699	497557	9905	507462
83-84	42813	39503	36003	34978	33649	33372	36144	39830	40518	39992	38954	38279	37458	491493	9784	501277
84-85	44113	40298	37990	35488	34734	33262	33292	36618	39604	41173	39160	37220	36000	488952	9734	498686
85-86	45714	41523	38755	37446	35240	34335	33182	33729	36411	40244	40317	37417	35004	489317	9741	499058

All enrollments are as of the second Friday in September. The public school enrollment projections are based upon the trends observed in the number of students moving from grade to grade. This trend calculated as an average cohort survival ratio was used to estimate 1st through 12th grade enrollments. Kindergarten enrollments were estimated from actual births five years prior.

*Ungraded special education refers to those students who are not associated with a given grade level. This is not a count of the number of special education students in the state.

Information contained in this table was develped and released by the Department of Public Instruction, Grimes State Office Building, Des Moines, IA 50319

TABLE 2

COMPARISON OF THE NUMBER OF FALL VACANCIES IN MATHEMATICS AND SCIENCE IN THE PUBLIC SCHOOLS OF IOWA WITH THE NUMBER OF BACHELOR DEGREE GRADUATES CERTIFICATED TO TEACH FROM THE TWENTY-SEVEN IOWA INSTITUTIONS FOR THE YEARS INDICATED

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
MATH											
Vacancies			196	214	217	189	221	185	189	165	177
Graduates	234	218	228	207	166	95	104	75	60	46	49
SCIENCE											
Vacancies			172	261	248	176	217	176	156	159	110
Graduates	269	255	190	212	192	185	187	190	155	117	100

The demand for mathematics teachers has fluctuated around 200 per year, with a low of 165 and a high of 221 for the years studied. For comparison, in 1972 there were 196 vacancies and in 1980 there were 177.

Although the information on demand for mathematics teachers is high, as evidenced by the number of vacancies reported in Table 2, many additional positions have been reported as combined assignments requiring the teaching of mathematics plus various other science subjects. This is particularly true of the smaller school districts with limited enrollments and small class sizes. In Iowa the number of teachers with math/science combination of teaching assignments increased from 245 to 282 in five years.[9] Therefore, the full time math vacancies reported in Table 2 are very conservative since the combinations are not shown.

Science

A summary of the number of bachelor degree graduates prepared in Iowa for all science areas is reported in Table 3. The supply of science teachers was obtained by tabulating the number of certificated bachelor degree graduates from the 27 teacher education institutions. There were 269 science teacher graduates in 1970 and only 100 graduates in 1980.

Even though the information requested from the institutions separated the science subject areas, most institutions prepared teachers as generalists to teach combinations of several science areas. Therefore, in Table 3 the number of graduates is indicated for each subject area as well as combined science. However, this detailed analysis was useful in identifying areas with critical shortages. These were namely general science, earth science, physics, and chemistry.

The demand for science teachers was obtained by analyzing the reported vacancies ranging from a high of 261 in 1973 to a low of 110 in 1980 (see Table 2). During most of the period studied the vacancies exceeded the

TABLE 3

SUMMARY OF THE NUMBER OF GRADUATES FROM THE TWENTY-SEVEN TEACHER EDUCATION INSTITUTIONS IN IOWA COMPLETING PREPARATION FOR A TEACHING CERTIFICATE WITH A BACHELOR DEGREE BY SUBJECT AREA FOR THE YEARS 1970-80

	Number of Graduates by Year										
Subject Area	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
SCIENCE											
Combined	57	56	29	24	60	61	77	71	56	42	49
Biology	137	129	107	119	84	77	66	66	61	52	36
Chemistry	17	15	19	17	16	13	11	16	13	7	5
Earth Science	0	0	0	0	7	4	12	6	7	2	3
General Science	43	40	16	34	7	7	7	14	5	12	5
Physical Science	0	0	0	0	9	14	7	11	8	0	0
Physics	15	15	19	18	9	9	7	6	5	2	2
TOTALS	269	255	190	212	192	185	187	190	155	117	100

number of graduates. However, these figures included all science vacancies. There appears to be an adequate or balanced supply of biology teachers but a critical shortage of teachers in the physical sciences.

Characteristics of Mathematics and Science Teachers

A profile of the staff characteristics of all teachers of mathematics and science in Iowa public schools was made from the computer analysis of the Basic Education Data Survey (BEDS) tape maintained by the Department of Public Instruction. Characteristics examined were age, experience, education, and teaching assignment.

Results seemed to indicate that the smaller school districts were employing primarily beginning teachers, who were recent bachelor degree candidates with no teaching experience in science. Teachers with the masters degree and additional teaching experience were common in the larger school districts (see Tables 4 & 5). Table 6 provides comparison of those teachers who were teaching science in their major and non-major in 1973-74. A change is evident when the same data are examined for 1978-79 or five years later. Another computer run indicated that many teachers currently teaching science on temporary certification because of shortages of qualified personnel. Another interesting aspect of the analysis was that 13% of the teachers in all districts were in the 51-60 year old category suggesting the need for replacement in the future in the areas of mathematics and science.

Summary

There were many factors effecting the teacher supply and demand during the 1970's. These were inflation, major changes in the economy, a period of recession 1973-75, national unemployment, federal grants, lower birth rates, and declining school enrollments.[10,11]

TABLE 4 Iowa Public High School Science Teachers by Subject Area, Education and School District Size (1973-74)

K-12 District Enrollment	Biology			Chemistry			Physics			Physical Science			Earth Science			Conservation			General Science		
	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL
Less than 500	116	22	138	72	24	96	60	25	86[e]	49	9	58	49	10	59	2	1	3	100	18	118
500-749	112	30	143[a]	60	32	94[d]	59	31	91[f]	49	13	63[g]	43	11	55[i]	4	2	6	112	22	135[j]
750-999	79	37	116	43	27	70	41	27	68	38	26	64	37	9	46	8	1	9	90	28	118
1,000-1,499	66	24	90	22	27	49	20	29	49	33	16	49	30	11	41	2	2	4	77	18	95
1,500-1,999	38	15	54[b]	8	15	23	7	16	23	14	13	27	15	9	24	2	3	5	40	16	56
2,000-2,999	47	50	97	12	24	36	15	23	38	27	25	52	24	22	46	4	4	8	86	41	127
3,000 or more	109	140	252[c]	20	49	69	5	43	48	72	71	146[h]	43	52	95	7	11	18	205	126	334[k]
TOTAL	567	318	890	237	198	437	207	194	403	282	173	459	241	124	366	29	24	53	710	269	983

Key:
a - 2 specialists
b - 1 doctorate
c - 1 doctorate
d - 2 doctorates
e - 1 specialist
f - 1 doctorate
g - 1 doctorate
h - 1 specialist, 2 doctorates
i - 1 doctorate
j - 1 doctorate
k - 1 specialist, 2 doctorates

TABLE 5 Iowa Public High School Science Teachers by Subject Area, Education and School District Size (1978-79)

K-12 District Enrollment	Biology			Chemistry			Physics			Physical Science			Earth Science			Conservation			General Science		
	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL	BA	MA	TOTAL
Less than 500	179	37	216	103	33	136	88	27	116[d]	61	14	75	60	9	69	13	3	16	130	32	162
500-749	100	27	127	59	29	89[b]	52	26	79[e]	36	19	56[f]	45	7	52	10	2	12	96	15	111
750-999	88	27	115	42	22	64	29	27	56	30	24	54	36	7	43	10	1	11	85	25	111[g]
1,000-1,499	58	26	84	14	23	37	15	21	36	25	12	37	27	7	34	5	3	8	57	16	73
1,500-1,999	42	22	64	11	17	28	13	15	28	21	15	36	12	15	27	6	4	10	42	16	58
2,000-2,999	45	37	82	10	19	30[c]	10	20	30	18	14	32	19	9	28	4	2	6	52	18	70
3,000 or more	108	140	250[a]	21	47	68	11	36	47	54	65	119	45	41	86	14	17	31	163	135	298
TOTAL	620	316	938	260	190	452	218	172	392	245	163	409	244	95	339	62	32	94	625	257	883

Key:
a - 1 specialist, 1 doctorate
b - 1 specialist
c - 1 doctorate
d - 1 specialist
e - 1 specialist
f - 1 specialist
g - 1 specialist

12

TABLE 6 Iowa Science Teachers with Undergraduate or Graduate Majors in their Teaching Area by Subject and School District Size

1973-74

K-12 District Enrollment	Biology		Chemistry		Physics		Physical Science	
	Major	Non Major	Major	Non Major	Major	Non Major	Major	Non Major
Less than 500	81	57	23	73	11	75	7	51
500-749	80	63	24	70	17	74	3	60
750-999	59	57	30	40	15	53	9	55
1,000-1,499	55	35	18	31	14	35	1	48
1,500-1,999	35	19	12	11	8	15	4	23
2,000-2,999	78	19	16	20	14	24	9	43
3,000 or more	170	82	32	37	19	29	11	135
TOTAL	558	332	155	282	98	305	44	415

1978-79

K-12 District Enrollment	Biology		Chemistry		Physics		Physical Science	
	Major	Non Major	Major	Non Major	Major	Non Major	Major	Non Major
Less than 500	133	83	36	100	13	103	8	67
500-749	70	57	31	58	19	60	10	46
750-999	65	50	30	34	13	43	3	51
1,000-1,499	47	37	14	23	7	29	3	34
1,500-1,999	45	19	14	14	10	18	7	29
2,000-2,999	54	28	9	21	8	22	5	27
3,000 or more	173	77	37	31	20	27	15	104
TOTAL	587	351	171	281	90	302	51	358

Major findings of the investigation are the following:

(1) The Supply of math and science teachers as measured by the number of bachelor degree graduates who have been certificated has been declining in Iowa.

(2) Competition in hiring from business and industry, especially within the past two years, has dramatically changed the job market. Prospective math and science teacher education candidates are being attracted by higher paying jobs in business. Teachers with one to five years of experience are also leaving for higher salaries in the business sector.

(3) There are critical shortages of teachers in the areas of mathematics and science. In the science area, there are shortages in general science, earth science, physics, and chemistry.13

(4) Long-range consequences of continued critical shortages on the total education system can be extremely serious. Many math and science courses are being taught by less qualified teachers with minimal preparation in these subjects. Many schools will be forced to drop some mathematics and science offerings because of staff shortages.

In conclusion, the prospects for an easy or immediate solution to the mathematics and science teacher shortage in Iowa seems improbable and will probably worsen in the next few years. When the economy remains stable, the competition from business and industry for the services of people with these skills remains high. At the time of this study, salaries paid by industry were approximately 50% higher than for teaching on an annual basis. In a recessionary period, the opportunities for alternative employment in the private sector decrease significantly. This results in many more qualified applicants for fewer jobs. This problem is further compounded during times of declining enrollment and staff reductions.

THE NATIONAL STUDY

Problem

Since it is known that Iowa imports approximately 25% of its teachers from out of state, and about the same percentage go out of state to teach, it was decided that knowing the status of, at least, states contiguous to Iowa might assist in alleviating shortage problems. Following telephone surveys with State Departments in Minnesota, Illinois, Missouri, North Dakota, South Dakota, Nebraska, and Wisconsin, it was concluded that these states were also experiencing similar shortages. This information has prompted a concern to pursue the investigation on a national scale.

In the early 1960's, inadequate supplies of science teachers precipitated a series of actions and overreactions that, with proper planning and data, might have been averted. In an attempt to ascertain if this surge of requests represented the beginnings of such a repeat shortage, certain data needed to be examined. This study was designed to first ascertain the availability of such data.

The purpose of this study was to investigate the problems of teacher supply and demand of secondary mathematics and science teachers for all states in the U.S.

Methodology

A major concern in the initial planning states was the availability of information for a national survey to determine the supply and demand of secondary mathematics and science teachers. Supply as reflected by certification was used as a criterion in each of the states. Whereas, demand is best reflected by the school hirings to fill vacancies each year.

Preliminary Telephone Survey

The decision was made to conduct a preliminary telephone survey by

contacting the director of teacher education and certification in each state. The 1979-80 director of the National Association of State Directors of Teacher Education and Certification was used for contacting each director.

An instrument was developed (see Appendix A) to standardize the communication and phrasing of the questions used in the telephone survey. Between January and April 1980, the Iowa State University Education Placement Office and the Iowa Department of Public Instruction conducted a telephone survey. Each state department of teacher certification division or data control division was contacted to assess the availability of math and science teacher supply/demand information.

Telephone calls were made and interviews completed for a sample of Directors of Teacher Education and Certification in the State Departments of Public Instruction for each of thirty states (see Table 7). Telephone calls were made at least once to all states. However, in some states the director was not immediately available on the first or second telephone call. It was decided for this preliminary survey to report on only the sample of states where interviews had been completed.

Two major problems developed, one was concerned with costs for computer runs or the hand tabulation and the second was time involved to collect information that was not currently available. These two factors--time and money--appeared to be beyond the present resources to conduct the study as originally planned. Alternative approaches to assess supply and demand were then explored.

State Science Supervisors Questionnaire

The feasibility of contacting the supervisor or consultant in science education for each state department of education emerged as a reasonable approach for obtaining information.

Dr. Jack Gerlovich, Consultant, Science Education for the State Depart-

ment of Public Instruction In Iowa, contacted Lonnie Love, the president of the Council of State Science Supervisors (CS^3). He requested and received permission for time on the program at their national meeting at Anaheim, California, in late March, 1980.

The preliminary results of the telephone survey were presented by Dr. Gerlovich at the national meeting. He then presented the proposed study and received unanimous approval and endorsement from the members present to proceed with the questionnaire survey. They expressed a deep concern and willingness to cooperate.

Copies of the cover letters of request from Lonnie Love (President, CS^3), Trevor Howe (Director, Education Placement, ISU) and Jack Gerlovich (Iowa DPI) appear in Appendix B and C.

The questionnaires were mailed on April 15, 1980, to all state science supervisors (see copy Appendix D).

Findings

Telephone Survey

A preliminary telephone survey was conducted in each state by contacting the director of the state teacher education and certification division. The purpose of the survey was to assess the availability of math and science teacher supply/demand information. The schedule in Appendix A was used to ensure the same communication and phrasing of questions for each telephone call. These calls were started in January and continued through March 1980. Personnel of the Iowa State University Education Placement Office and the Iowa Department of Public Instruction conducted the telephone survey.

A summary of the telephone survey on the availability of information on the supply and demand of secondary mathematics and science teachers for a sample of thirty states is reported in Table 7. Information has been reported only for the sample of states where the interviews were completed. Telephone calls were made to all states, but in some states the director was not available on either the first or second telephone call.

Results of the preliminary telephone survey for the thirty states are reported in Table 7. They can best be summarized as follows:

Supply as indicated by certification:

(1) Is information available on the number of current bachelor degree graduates recommended for certification from July 1, 1978 to July 1, 1979 in mathematics and science?
Responses: 15 - Yes, 15 - No

(2) Is information available on the number of temporaries granted in mathematics and science?
Responses: 17 - Yes, 12 - No, 1 - ?

TABLE 7 Summary of a Telephone Survey on the Availability of Information on the Supply and Demand of Secondary Mathematics and Science Teachers for a Sample of Thirty States

	SUPPLY		DEMAND	
STATE	Number Certificated BS Grads	Number Temporaries	Number First Year Teachers	Info. on Begin. or Expr. Teachers
*Alabama	No	Yes	Yes	Yes
Alaska	Yes	Yes	Yes	Yes
Arizona	No	No	No	No
Arkansas	No	No	Yes	Yes
California	No	No	No	No
Colorado	Yes	Yes	Yes	No
Connecticut	No	?	Yes	?
Delaware	Yes	Yes	Yes	No
District of Columbia	Yes	Yes	Yes	Yes
Florida	No	No	No	No
Georgia	Yes	Yes	Yes	Yes
Idaho	No	Yes	Yes	No
Illinois	No	No	Yes	Yes
Indiana	Yes	Yes	Yes	Yes
*Iowa	Yes	Yes	Yes	Yes
Kansas	No	No	No	No
Kentucky	No	Yes	Yes	Yes
Louisiana	No	Yes	Yes	Yes
Maine	No	No	Yes	No
Michigan	Yes	No	Yes	Yes
Minnesota	Yes	Yes	Yes	Yes
*Missouri	Yes	Yes	Yes	No
Montana	No	No	No	No
*Nebraska	Yes	Yes	Yes	No
Nevada	Yes	No	No	No
New Hampshire	Yes	No	Yes	Yes
*Mew Mexico	No	Yes	Yes	Yes
North Dakota	Yes	No	Yes	Yes
Oklahoma	No	Yes	No	No
*Wisconsin	Yes	Yes	Yes	Yes

* Indicates computerized

The number of temporaries granted in mathematics and science were considered an indication of shortages, but a few states do not issue temporaries.

Demand as indicated by vacancies or hirings by Fall 1979.

(1) Is information available on the number of teacher who are in their first year of teaching in all school districts in the state for 1979-80?

Responses: 23 - Yes, 7 - No

(2) Can they be identified as beginning teachers or experienced?

Responses: 16 - Yes, 13 - No, 1 - ?

Other:

All states indicated that they would need financial assistance to provide the information previously discussed. Six states indicated that they were fully computerized. Several others indicated that they were in the process of computerizing the data and it would probably take another year to complete. The estimated costs varied from fifty dollars per computer run to five hundred dollars for the information requested. Others indicated they would have to charge for personnel time to hand tabulate the information requested, based upon an hourly charge. Some individual staff persons at colleges or universities were identified in a few states as having conducted state teacher supply and demand surveys.

State Science Supervisor's Questionnaire

The information obtained from the State Science Supervisors in response to the mailed questionnaires served as a cross reference to establish the validity of the information obtained from the earlier preliminary telephone survey. An extremely high degree of consistency

was found between responses using the two approaches.

The mailed questionnaire (Appendix D) was used to collect information from the science supervisors in each state. Since numerical data were not available from all states, a summary table was developed to report the availability of information for Column I and II of the questionnaire. Table 8 provides a summary titled, "Availability of data on the number of individuals certificated and the number hired in each state."

The name of the science supervisor contacted in each state was given as well as the name of additional persons supplying information. Science supervisors in 30 states indicated that they could supply reliable quantitative data concerning teacher supply, while in 23 states information could be supplied concerning current demand.

The most useful and complete information obtained was the perceptions of the state science supervisors. The information was obtained by the analyses of Column III on the questionnaire. They were asked to circle the number that best describes the available supply of teachers for each of the majors listed. The rating key was (1) Surplus, (2) Slight Surplus, (3) Adequate, (4) Shortage, and (5) Critical Shortage.

Inspection of Table 9 provides a summary of the "Estimated supply of secondary biology, chemistry, physics, general science, earth science and mathematics teachers by state."

Perceptions of the science supervisors, CS^3 members, were tabulated in Table 9. The calculated mean ratings for the estimated supply of secondary teachers placed in rank order are as follows: physics 4.15, math 3.92, chemistry 3.71, earth science 3.67, general science 3.05, and biology 2.65. Interpretation of the data indicates shortages of teachers

in the areas of physics, math, chemistry and earth science. There appears to be an adequate supply of general science and biology teachers.

TABLE 8 Availability of Data on the Number of Individuals Certificated and the Number Hired in Each State

	I SUPPLY	II DEMAND	
STATE	Number of Individuals Certificated	First Year Teachers Hired	Persons Supplying Information
Alabama	no	no	Donna Bentley
Alaska	yes	yes	Emma L. Walton *Bina Harris
Arizona	NR		
Arkansas	yes	no	Charles Watson
California	NR		
Colorado	no	no	M. D. Spurlin
Connecticut	no	yes	Sigmund Abeles
Delaware	yes	yes	Douglas Macbeth *John C. Cairns
District of Columbia	no	no	Mary B. Harbeck
Florida	no	no	Jack M. Hopper *Robert S. Lumsden
Georgia	yes	yes	Lonnie A. Love *Dallas Stewart
Hawaii	yes	yes	Miles Muraoka
Idaho	yes	yes	Richard Kay
Illinois	no	yes	Don Roderick
Indiana	yes	yes	Jerry M. Colglazier *Victor A. Smith
Iowa	yes	yes	Jack Gerlovich
Kansas	yes	yes	Ramona Anshutz *W. S. LaShier, Jr.
Kentucky	no	no	Frank Howard
Louisiana	yes	no	Donald McGhee

NR - No response
* Individual completing questionnaire other than contact person

TABLE 8 Continued

STATE	I SUPPLY Number Individuals Certificated	II DEMAND First Year Teachers Hired	Persons Supplying Information
Maine	yes	yes	Douglas A. Stafford *Mr. McHatten
Maryland	yes	no	James W. Lathan, Jr. *Susan P. Snyder
Massachusetts	no	no	Raymond L. Gehling, Jr.
Michigan	yes	no	Jack W. Kammeraad
Minnesota	yes	yes	Richard Clark
Mississippi	yes	yes	Michael Carothers
Missouri	yes	yes	Jack Ray *John Allan & R. V. Wilson
Montana	no	no	Gary Hall
Nebraska	no	no	Donald Woodburn
Nevada	yes	yes	Jack S. O'Leary
New Hampshire	no	no	William Ewert
New Jersey	NR		
New Mexico	no	no	B. K. Graham
New York	yes	yes	Edward Lalor & Thomas Boehm *Douglas S. Reynolds
North Carolina	yes	yes	Paul Taylor & Clinton Brown
North Dakota	yes	yes	George Fors
Ohio	NR		
Oklahoma	yes	yes	Larry McKinney
Oregon	no	yes	Raymond Thiess
Pennsylvania	yes	no	John J. McDermott
Rhode Island	yes	no	Edward L. Dambruch

NR - No response
* Individual completing questionnaire other than contact person

TABLE 8 Continued

STATE	I SUPPLY Number of Individuals Certificated	II DEMAND First Year Teachers Hired	Persons Supplying Information
South Carolina	yes	no	Peggy Cain
South Dakota	NR		
Tennessee	no	no	John K. Bennett
Texas	NR		
Utah	yes	yes	Richard Petersen
Vermont	no	no	George Tanner
Virginia	yes	yes	Franklin D. Kizer & C. Dillard Haley, Jr. *Joseph D. Exline
Washington	no	no	James N. Garner *David A. Kennedy
West Virginia	yes	no	Robert Seymour
Wisconsin	yes	no	Kenneth Dowling
Wyoming	yes	no	William Futrell
American Samoa	yes	yes	Paul Stevenson

NR - No response
* Individual completing questionnaire other than contact person

TABLE 9 Estimated Supply of Secondary Biology, Chemistry, Physics, General Science, Earth Science and Mathematics Teachers by State

STATE	Biology	Chemistry	Physics	General Science	Earth Science	Math
Alabama	2	3	5	3	4	NR
Alaska	1	1	1	1	1	1
Arizona	NR	NR	NR	NR	NR	NR
Arkansas	3	4	4	3	3	4
California	2	2	4	3	4	2
Colorado	3	3.5	3.5	3.5	3.5	3.5
Connecticut	3	3	4	3	3	4
Delaware	3	3	3	3	3	3
District of Columbia	3	3	4	2	3	4
Florida	3	5	5	4	5	4
Georgia	1	1	1	1	1	1
Hawaii	2	4	4	3	4	3
Idaho	1	4	4	3	4	4
Illinois	3	5	5	4	4	5
Indiana	5	5	5	5	5	5
Iowa	2	5	5	3	4	5
Kansas	2	4	4	4	4	4
Kentucky	3	4	5	3	4	5
Louisiana	3	4	5	3	4	4
Maine	3	3.5	3.5	3.5	3.5	4
Maryland	3	4	4	4	4	4
Massachusetts	1	1	1	1	1	1
Michigan	3	4	4	3	3	4
Minnesota	2	3	4	3	3	NR
Mississippi	1	2	4	1	4	NR
Missouri	4	5	5	4	4	5
Montana	NR	NR	NR	NR	NR	NR

Rating key (1) Surplus, (2) Slight Surplus, (3) Adequate, (4) Shortage, (5) Critical Shortage

NR - No response

TABLE 9 Continued

STATE	Biology	Chemistry	Physics	General Science	Earth Science	Math
Nebraska	3	4	4	3	4	3
Nevada	3	4	5	3	3	4
New Hampshire	2	5	5	4	5	5
New Jersey	3	3.5	4	3	3	3
New Mexico	2	3	4	2	3	4
New York	3	4	5	3	4	5
North Carolina	4	5	5	4	4	5
North Dakota	3	4	4	4	4	4
Ohio	2	4	5	3	2	3
Oklahoma	2	4	5	2	5	5
Oregon	3	3	3	3	3	5
Pennsylvania	2	4	5	2	4	5
Rhode Island	NR	NR	NR	NR	NR	NR
South Carolina	4	5	5	4	5	5
South Dakota	3	4	5	3	3	3
Tennessee	3	3.5	3.5	3	4	3.5
Texas	2	3	3	4	5	5
Utah	3	4	4	3	4	4
Vermont	4	4	5	3	3	3
Virginia	1	3	4	2	5	4
Washington	3	4	4	3	4	3.5
West Virginia	3	5	5	4	4	5
Wisconsin	2	4	5	4	4	5
Wyoming	3	4	4	3	4	4
American Samoa	5	5	5	5	5	5
TOTAL	130	182	203.5	151	180	180.5
MEAN	2.65	3.71	4.15	3.05	3.67	3.92

Rating key (1) Surplus, (2) Slight Surplus, (3) Adequate, (4) Shortage, (5) Critical Shortage

NR - No response

Summary

This summary encompasses the results of the telephone survey of the Directors of State Teacher Certification Divisions, analysis of the questionnaires returned, the perceptions of the state science supervisors, and the results of the completed supply and demand studies of science and mathematics teachers conducted in Iowa.

Supply and demand are directly effected and correlate highly with economic conditions of the country. During a recessionary period the number of teaching vacancies are generally below normal and teachers make fewer job changes. In addition, there are usually more qualified people available during a period of depressed economic conditions. Currently the number of teacher education graduates being prepared in mathematics and science is not meeting the present educational needs let alone future predicted shortages.

The primary source of supply for secondary math and science teachers is the number of new certificated bachelor degree graduates each year. Supply as reflected by certification was used as a criterion in each of the states. Whereas, demand is best reflected by the school hirings each year to fill existing vacancies. Perceptions of the science supervisors, CS^3 members, indicated shortages of teachers in the physical science areas, specifically: physics, mathematics, chemistry, and earth science. There appears to be an adequate supply of general science and biology teachers.

The telephone survey was designed to ascertain the availability of hard data to serve as a base line or starting point. Questionnaires to the state science supervisors provided additional information. The results are summarized as follows:

1. Science supervisors in thirty states indicated that they could supply reliable quantitative data concerning teacher supply, while in 23 states information could be supplied concerning demand.
2. In six states personnel indicated they had computerized data. Several other states indicated they were in the process of converting to computer. Many states indicated their willingness to survey, collect, and hand tabulate where the information requested was not computerized, providing they could receive financial assistance to cover costs.
3. In those states which indicated that supply/demand information was not available through the state department of education, alternative contacts could be made through state universities and science faculty contacts.
4. Seventeen state teacher certification divisions contacted by telephone indicated they had information concerning the number of temporary certificates issued each year. Such temporary certificates generally are granted only in emergency situations when fully qualfied teachers are not available. This would also be another indication of shortages.

Implications

Although the two phases of this study focused upon qualitative information, responses were found to be quite reliable and consistent when the responses of the Directors of Teacher Certification and the State Science Supervisors were compared within each state. While this study focused upon qualitative assessment of available information, it did identify the sources of quantitative data.

Information on the number of teachers certificated in the areas of mathematics and science as well as the number of temporaries issued in each state was used to assess the availability of candidates and to identify areas of teacher shortages.

Financial restrictions of the researchers limited the collection of data from states where costs for computer runs or tabulations were assessed. Where information was not available or could not be obtained from the State Departments of Education, alternative means such as state surveys of colleges, schools, etc., are proposed to collect data, although this would involve additional expense.

Another source for verification of the data to be collected from the current proposed surveys would be to examine data that are available from ASCUS reports, NEA reports, or other sources. Future studies could be designed to sample AACTE or ASCUS institutions to collect data for possible cross validation with state department data.

Studies collected at this time may be atypical and underestimates of demand because of the present economic uncertainties. However, a strong argument for the need to establish sound base line data is apparent.

A system should be developed and implemented nationally to encourage

regular assessment of teacher supply and demand. Such studies could avert future crises and encourage career planning for prospective teachers.

As enrollment declines are experienced and teachers in the smaller schools are required to teach several courses or combined teaching assignments, the number of curriculum offerings will probably be reduced and the quality of the programs may be threatened.

In order to complete a quantitative study of national science teachers supply and demand, the following items should be considered in a cost analysis: (1) computer costs for analyzing the state data, (2) collection and hand tabulation of data in state departments in states where computerized data are not available, (3) possible surveys of teacher preparation institutions and local schools where such data are not available at state departments of education, (4) mailing cost, (5) overhead cost of the coordinating institution, (6) staff personnel cost, (7) printing, (8) telephone for follow-up, and (9) project related travel.

Although this study did not provide all the quantitative information necessary to make specific predictions, contacts were established in all states. It has served to develop the research design and lay the groundwork for future studies. The investigative activities did provide for the following: (1) the validity of the data was established, (2) preliminary cost estimates for specific data collection, (3) state science consultant's preceptions of math and science teacher supply and demand, and (4) teaching areas with critical shortages were identified. The information obtained from this study and the contacts made could shorten the time required for the planning stages of a follow-up study by at least six months to possibly a year.

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APPENDIX A

NATIONAL SURVEY
of
SECONDARY MATHEMATICS and SCIENCE TEACHERS

Preliminary Telephone Survey:

This is the Education Placement Office at Iowa State University. We are doing a preliminary telephone survey to determine the availability of information for a national survey to determine the supply and demand of secondary mathematics and science teachers. This is a cooperative study coordinated by the Department of Public Instruction and the Placement Office at Iowa State University.

Dr. Orrin Nearhoof, Director of Teacher Education and Certification in the Department of Public Instruction in Des Moines is serving as a consultant for our study. He suggested that we contact your office to determine if you have information computerized or available to answer the following questions?

Person contacted _____

Telephone number _____

Address _____

Supply as indicated by certification:	Responses
(1) Is information available on the number of current bachelor degree graduates recommended for certification from July 1, 1978 to July 1, 1979 in mathematics and science?	Yes No
(2) Is information available on the number of temporaries granted in mathematics and science?	Yes No
(3) Considering the number of temporaries granted in mathematics and science, is this an indication of shortages?	Yes No

Demand as indicated by vacancies or hirings by Fall 1979: Responses

(1) Is information available on the number of teachers who are in their first year of teaching in all school districts in the state for 1979-1980? Yes No

(2) Can they be identified as beginning teachers or experienced? Yes No

Other:

(1) In addition to mailing costs, would you need financial assistance to provide the information previously discussed? Yes No

Estimated cost _____

(2) Are there other sources for this information if you don't have it? Yes No

Source: Person _____

Telephone _____

Address _____

Thank you for your help! You will probably be contacted this spring with a mailed questionnaire.

If you have questions concerning this study please contact:

Dr. Trevor G. Howe	ISU	515-294-7020
Dr. Jack Gerlovich	DPI	515-281-3249

APPENDIX B

COUNCIL OF STATE SCIENCE SUPERVISORS
ROOM 207 EDUCATION ANNEX
156 TRINITY AVENUE
ATLANTA, GEORGIA 30303

Dear CS[3] Member:

The enclosed questionnaire is an important step in gathering vital information about one of the issues identified at our meeting in Anaheim. Your cooperation in responding promptly and completely is greatly appreciated.

The packet is self-explanatory and I am sure that each of you recognizes the need for a comprehensive and geographically complete data base.

Thank you for all your good efforts in science for our schools.

Sincerely,

Lonnie Love, President
Council of State Science Supervisors

LL/bk

Enclosure

STATE OF IOWA • DEPARTMENT OF PUBLIC INSTRUCTION
GRIMES STATE OFFICE BUILDING • DES MOINES, IOWA 50319

Iowa
a place to grow

ROBERT D. BENTON, Ed.D., STATE SUPERINTENDENT
David H. Bechtel, M. S., Administrative Assistant
JAMES E. MITCHELL, Ph.D., DEPUTY SUPERINTENDENT

April 15, 1980

Mrs. Mary B. Harbeck
Assistant Director, Science
Department of Education
415 S. 12th Street, N.W.
Washington, D.C. 20004

Dear Mary:

The vital need for data concerning the supply and demand of secondary school Science and Mathematics teachers by Science Supervisors, and the National Science Foundation was discussed at the Anaheim meeting of the Council of State Science Supervisors (CS^3). It was the unanimous opinion of all members present that CS^3 would assist in this effort. We are therefore requesting your assistance in securing this data.

Please complete the enclosed one page survey by May 16, 1980 and return to Dr. Trevor Howe.

This is a cooperative study carried out jointly by CS^3, the Iowa Department of Public Instruction and Iowa State University.

Results of the complete study will be shared with you.

Thank you for your assistance in this important endeavor.

Respectfully,

Trevor G. Howe

Trevor G. Howe, Ph.D.
Professor of Education
College of Education
219 Curtiss Hall
Iowa State University
Ames, Iowa 50011

Jack A. Gerlovich
Consultant, Science Education
Basic Instructional Programs Section
Department of Public Instruction

TGH:JAG:pjm

Enclosure

APPENDIX D QUESTIONNAIRE

Teacher Supply and Demand
in the Areas of
Mathematics and Science
for
1979-80 School Year

Please complete the following:

1. Name of State: _____

2. Address: _____

_____

3. Official Supplying the Information: _____

4. Telephone Number: _____

5. Date: _____

INSTRUCTIONS

The attached form is designed to identify the supply and demand of Mathematics and Science teachers in your state. Please enter the totals on the numbered lines for Life Science, Physical Science, and Mathematics. If you have information for the lettered lines please write those numbers also.

Column I Supply: Please report the number of individuals who completed the Bachelor's degree 9/1/78 to 8/31/79 and met all the certification requirements to teach in elementary or secondary schools. Please report each person only in their major field of specialty.

Column II Demand: Please report the number of individuals who were hired to fill a vacancy and were in their first year of teaching in that school during the 1979-80 school year.

Column III Estimated Supply: Please circle the number that best describes the available supply of teachers for each of the majors listed.

(over)

Teacher Supply and Demand in the Areas of Mathematics and Science for 1979-80 School Year

Majors	I Supply: Number of Individuals Certificated	II Demand: First Year Teachers Hired	III Estimated Supply: Surplus	Slight Surplus	Adequate	Shortage	Critical Shortage
1. Life Science (Total)			1	2	3	4	5
(a) Biology			1	2	3	4	5
(b) Others			1	2	3	4	5
2. Physical Science (Total)			1	2	3	4	5
(a) Chemistry			1	2	3	4	5
(b) Physics			1	2	3	4	5
(c) Physical Science			1	2	3	4	5
(d) General Science			1	2	3	4	5
(e) Earth Science			1	2	3	4	5
(f) Others			1	2	3	4	5
3. Mathematics (Total)			1	2	3	4	5

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